

## RECTIFICATION OF RIO GRANDE

*Convention signed at México February 1, 1933, with annexes and exchanges of notes*

*Senate advice and consent to ratification, with an amendment, April 25, 1933*<sup>1</sup>

*Ratified by Mexico October 6, 1933*

*Ratified by the President of the United States, with an amendment, October 20, 1933*<sup>1</sup>

*Ratifications exchanged at Washington November 10, 1933*

*Entered into force November 10, 1933*

*Proclaimed by the President of the United States November 13, 1933*

48 Stat. 1621; Treaty Series 864

### CONVENTION BETWEEN THE UNITED STATES OF AMERICA AND THE UNITED MEXICAN STATES FOR THE RECTIFICATION OF THE RIO GRANDE (RIO BRAVO DEL NORTE) IN THE EL PASO-JUAREZ VALLEY

The United States of America and the United Mexican States having taken into consideration the studies and engineering plans carried on by the International Boundary Commission, and specially directed to relieve the towns and agricultural lands located within the El Paso-Juarez Valley from flood dangers, and securing at the same time the stabilization of the international boundary line, which, owing to the present meandering nature of the river it has not been possible to hold within the mean line of its channel; and fully conscious of the great importance involved in this matter, both from a local point of view as well as from a good international understanding, have resolved to undertake, in common agreement and cooperation, the necessary works as provided in Minute 129 (dated July 31, 1930) of the International Boundary Commission, approved by the two Governments in the manner provided by treaty; and in order to give legal and final form to the project, have named as their plenipotentiaries:

The President of the United States of America, J. Reuben Clark, Jr., Ambassador Extraordinary and Plenipotentiary of the United States of America to Mexico; and

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<sup>1</sup> The United States amendment called for correcting the date at the close of art. V from Nov. 20, 1905, to Mar. 20, 1905.

The text printed here is the amended text as proclaimed by the President.

The President of the United Mexican States, Doctor José Manuel Puig Cassauranc, Secretary of State for Foreign Affairs;

Who, after having communicated their respective full powers and having found them in due and proper form, have agreed on the following articles:

## I

The Government of the United States of America and the Government of the United Mexican States have agreed to carry out the Rio Grande rectification works provided for in Minute 129 of the International Boundary Commission and annexes thereto, approved by both Governments, in that part of the river beginning at the point of intersection of the present river channel with the located line as shown in map, exhibit No. 2 of Minute 129 of said Commission (said intersection being south of Monument 15 of the boundary polygon of Córdoba Island) and ending at Box Canyon.

The terms of this Convention and of Minute 129 shall apply exclusively to river rectification within the limits above set out.

The two Governments shall study such further minutes and regulations as may be submitted by the International Boundary Commission and, finding them acceptable, shall approve same in order to carry out the material execution of the works in accordance with the terms of this Convention. The works shall be begun after this Convention becomes effective.

## II

For the execution of the works there shall be followed the procedure outlined in the technical study of the project. The works shall be begun and shall be carried on primarily from the lower end, but at the same time and for reasons of necessity works may be carried on in the upper sections of the valley.

## III

In consideration of the difference existing in the benefits derived by each of the contracting countries by the rectification works, the proratable cost of the works will be defrayed by both Governments in the proportion of eighty-eight per cent (88%) by the United States of America and of twelve per cent (12%) by the United Mexican States.

## IV

The direction and inspection of the works shall be under the International Boundary Commission, each Government employing for the construction of that portion of the work it undertakes, the agency that in accordance with its administrative organization should carry on the work.

## V

The International Boundary Commission shall survey the ground to be used as the right of way to be occupied by the rectified channel, as well as the parts to be cut from both sides of said channel. Within thirty days after a cut has been made, it shall mark the boundaries on the ground, there being a strict superficial compensation in total of the areas taken from each country. Once the corresponding maps have been prepared, the Commission shall eliminate these areas from the provisions of Article II of the Convention of November 12, 1884,<sup>2</sup> in similar manner to that adopted in the Convention of March 20, 1905<sup>3</sup> for the elimination of bancos.

## VI

For the sole purpose of equalizing areas, the axis of the rectified channel shall be the international boundary line. The parcels of land that, as a result of these cuts or of merely taking the new axis of the channel as the boundary line, shall remain on the American side of the axis of the rectified channel shall be the territory and property of the United States of America, and the territory and property of the United Mexican States those on the opposite side, each Government mutually surrendering in favor of the other the acquired rights over such parcels.

In the completed rectified river channel—both in its normal and constructed sections—and in any completed portion thereof, the permanent international boundary shall be the middle of the deepest channel of the river within such rectified river channel.

## VII

Lands within the rectified channel, as well as those which, upon segregation, pass from the territory of one country to that of the other, shall be acquired in full ownership by the Government in whose territory said lands are at the present time; and the lands passing as provided in Article V hereof, from one country to the other, shall pass to each Government respectively in absolute sovereignty and ownership, and without encumbrance of any kind, and without private national titles.

## VIII

The construction of works shall not confer on the contracting parties any property rights in or any jurisdiction over the territory of the other. The completed work shall constitute part of the territory and shall be the property of the country within which it lies.

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<sup>2</sup> TS 226, *ante*, p. 865.

<sup>3</sup> TS 461, *ante*, p. 920.

Each Government shall respectively secure title, control, and jurisdiction of its half of the flood channel, from the axis of that channel to the outer edge of the acquired right of way on its own side, as this channel is described and mapped in the International Boundary Commission Minute number 129, and the maps, plans, and specifications attached thereto, which Minute, maps, plans, and specifications are attached hereto and made a part of this Convention.<sup>4</sup> Each Government shall permanently retain full title, control, and jurisdiction of that part of the flood channel constructed as described, from the deepest channel of the running water in the rectified channel to the outer edge of such acquired right of way.

#### IX

Construction shall be suspended upon request of either Government, if it be proved that the works are being constructed outside of the conditions herein stipulated or fixed in the approved plan.

#### X

In the event there be presented private or national claims for the construction or maintenance of the rectified channel, or for causes connected with the works of rectification, each Government shall assume and adjust such claims as arise within its own territory.

#### XI

The International Boundary Commission is charged hereafter with the maintenance and preservation of the rectified channel. To this end the Commission shall submit, for the approval of both Governments, the regulations that should be issued to make effective said maintenance.

#### XII

Both Governments bind themselves to exempt from import duties all materials, implements, equipment, and supplies intended for the works, and passing from one country to the other.

#### XIII

The present Convention is drawn up both in the English and Spanish languages.

#### XIV

The present Convention shall be ratified by the High Contracting Parties in accordance with their respective laws, and the ratifications shall be exchanged in the City of Washington as soon as possible. This Convention will come into force from the date of the exchange of ratifications.

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<sup>4</sup> Maps not printed here.

In witness whereof the Plenipotentiaries mentioned above have signed this Convention and have affixed their respective seals.

Done in duplicate at the City of Mexico this first day of February one thousand nine hundred and thirty-three.

J. REUBEN CLARK, JR. [SEAL]  
PUIG [SEAL]

#### ANNEXES <sup>5</sup>

MINUTE 129 OF THE INTERNATIONAL BOUNDARY COMMISSION DATED JULY 31, 1930, AND ANNEXES THERETO, REFERRED TO IN ARTICLE I OF THIS CONVENTION

#### INTERNATIONAL BOUNDARY COMMISSION UNITED STATES AND MEXICO

MEXICO CITY

*July 31, 1930*

MINUTE NO. 129

Subject: Report on Rio Grande Rectification

The Commission met in the conference room at the Department of Foreign Relations, Mexico City, at ten o'clock a.m. July 31, 1930, in accordance with Minute No. 128, to complete its action in reporting and recommending a plan for Rio Grande rectification.

(1) Each section of the International Boundary Commission has been requested by the Foreign Relations Department of its Government to study and develop an international plan for the removal of the flood menace of the Rio Grande from the El Paso-Juarez Valley. Studies and investigations have now reached the point where it is possible to report to the two Governments a definite plan with estimates of cost; and the following is the report of the International Boundary Commissioners, together with a joint report prepared by the consulting engineers and technical advisers. Minute No. 111 of the Joint Commission, dated December 21, 1928, outlined in a general way the necessities for international action and gave a general description of the areas involved, a preliminary summary of the proposed plan and recommended proceeding with the development of the final details of the plans and estimates. During the past few months a most important step taken by the Commission consisted in rendering decisions determining the national jurisdiction and dominion of a number of banco cases in the area under consideration.

(2) The plan prepared and developed by the Joint Commission is attached hereto as an exhibit to this minute. In transmitting it to the two Governments the Commissioners offer it as being both practical and feasible as an engineering and economic project. In general the plan consists of

<sup>5</sup> For an understanding relating to the texts of the annexes, see exchange of notes, p. 1001.

straightening the present river channel, effecting decrease in length from one hundred fifty-five (155) miles to eighty-eight (88) miles, and confining this channel between two parallel levees. In addition to this channel the plan includes the construction of a flood retention dam at the only available site, twenty-two (22) miles below Elephant Butte on the Rio Grande, creating reservoir storage of one hundred thousand (100,000) acre feet. Careful studies based on actual past flood performance show the advantage of reducing the flood flow reaching El Paso-Juarez by storage in the proposed reservoir. The reduction in flood flow thru the El Paso-Juarez Valley accomplished by such storage of flood waters effects a saving of a quarter of a million dollars in the works required thru the valley by decreasing the size of the channel and reducing the area required for right-of-way, and amount of yardage in levees.

(3) The meandering and uncontrolled Rio Grande below El Paso-Juarez has in recent years become a very serious menace to adjacent lands on both sides. Authorities of both countries have unsuccessfully attempted the protection of the improvements in the El Paso-Juarez Valley and the two cities. Considering the futility of providing adequate and proper protection on the present meandering river location, the two affected communities have expended the limit of a reasonable and justifiable amount in local flood protection works. A proper and sound plan for accomplishing desired results lies in a coordinated international project.

(4) Existing treaties provide for the center of the Rio Grande, except in isolated cases, being the International Boundary line. The present river channel, with excessive length, was produced by natural conditions which no longer exist. Increase in settlement, cultivation and values justify both Governments in considering means of removing the flood menace and providing an adequate flood channel.

(5) Actual field surveys were continued in the location on the ground of a rectified channel subject, of course, to some later slight modification, but generally sufficiently definite to permit estimates of right-of-way and construction costs. With office and field location of this channel line which generally follows and straightens the present meandering river, it has been possible to estimate acreages and values of the relatively small areas that would be detached from one country and attached to the other—so balanced in area that neither country would gain nor lose national territory.

(6) At the present time the bed of the Rio Grande between El Paso and Juarez is at a higher elevation than some of the streets and other properties of the two cities. Accumulations of sediment are continuing to aggravate this situation, and until proper grades and hydraulic conditions are introduced by artificial works, there are no means for carrying off these deposits which are encroaching upon the carrying capacity of the channel. The consensus of opinion of engineers who have studied the situation is that the correction lies in the plan proposed of straightening and confining the

channel. One of the principal requirements to permit such artificial rectification is the equitable adjustment of the areas which would be necessarily detached from one side of the river and attached to the other in the straightening process. The plan evolved, of having each Government acquire the private titles to these equal areas for later exchange, provides a feasible solution. These areas to be acquired are generally seeped and water-logged, and so shaped and situated as to be unsusceptible of proper irrigation and drainage.

(7) The benefits to be derived from the straightened and rectified channel plans are mutual to the two Governments-in affording flood protection and in permitting cultivation, improvement and settlement of even larger areas adjoining the Rio Grande than are now possible under the meandering river conditions. It is of utmost importance that the Governments own and control the flood channel in order that private encroachments be definitely prevented and eliminated. Such ownership and control will also be of great assistance in the enforcement of national immigration and customs laws of both countries.

(8) In giving consideration to the determination of proper and justifiable proration of costs between the two countries, conditions other than gross and irrigated areas are necessarily included. Economic features and values in the two countries are distinct and different. While the use of areas may be entirely proper in a distribution of costs for irrigation development, this unit of proration for an international flood control plan is unsuitable and produces serious irregularities. The Commission has taken into consideration the benefits that each country would receive according to the areas and their values to be protected rather than the benefits each would receive on the sole acreage basis. On the American side of the valley there are about fifty-three thousand (53,000) acres of land under the Rio Grande Federal Irrigation Project with water rights assured; the greater part of which is in full cultivation, and about seventeen thousand (17,000) acres in the lower portion of the valley below the project limits which are irrigated with project surplus water. The total irrigated area is seventy thousand (70,000) acres. This area is served with irrigation and drainage works, and first-class roads. Finance companies facilitate the financing of the production and distribution of agricultural products.

(9) On the Mexican side of the valley there are about thirty-five thousand (35,000) acres of land in cultivation, of which twenty thousand (20,000) acres have assured water rights under the Rio Grande Federal Irrigation Project, provided for by the Water Treaty of 1906.<sup>6</sup> Practically no drainage works have been constructed and the irrigation works are largely insufficient. The productiveness of the lands on the Mexican side is under

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<sup>6</sup> Convention signed at Washington May 21, 1906 (TS 455, *ante*, p. 924).

these circumstances much less than the corresponding lands on the north side of the river, and there are large areas with insignificant or no production. No major road improvements exist, and the finance companies organized to serve Mexican farmers are very limited in number and resources. The industrial plants and means for handling agricultural products are in very small proportion when compared with those in the valley in the United States.

(10) The estimated value of agricultural investments in the American part of the valley, according to figures assembled by the Bureau of Reclamation, including purchase of land and its preparation, farm improvements, equipment and live stock, is seventeen million dollars (\$17,000,000) or thirty-four million gold pesos. The value of agricultural improvements on the Mexican side as estimated by Engineer Salvador Arroyo, Chief of the Flood Protection Work, is five million four hundred thousand (\$5,400,000) gold pesos. Comparing these agricultural values in one part of the valley with those in the other it is seen that the Mexican side represents thirteen per cent of the total and the American eighty-seven per cent. Valley lands on either side of the river without water rights and assured irrigation service have very nominal value as compared with the lands obtaining water service from project sources; a comparison of such areas on this basis results in twenty-seven per cent for Mexico and seventy-three per cent for the United States.

(11) As the cities and suburbs of El Paso and Juarez not only are included in the flood protection plan, but either directly or indirectly would receive a large part of the benefits of the rectification of the channel, the Commission has considered the proration of values which each city bears to the other and giving proper weights to various percentages, believes the justifiable proration to be twelve (12) per cent for Mexico and eighty-eight (88) per cent for the United States.

(12) With reference to the estimates (exhibit number five <sup>7</sup> of the engineers' report) the grand total of six million one hundred six thousand five hundred dollars (\$6,106,500) includes certain items in which the Commissioners concur as being non-proratable and properly and practically chargeable to each Government separately. These are: rights-of-way four hundred twelve thousand five hundred dollars (\$412,500), for purchase of private channel rights above Cordova seventy-five thousand dollars (\$75,000), segregated tracts two hundred sixty-six thousand dollars (\$266,000), changes in irrigation works two hundred twenty-five thousand dollars (\$225,000). The total of these items, with twenty per cent overhead and contingencies is one million one hundred seventy-four thousand two hundred dollars (\$1,174,200). This amount subtracted from the grand total leaves a proratable total of four million nine hundred thirty-two thousand three hundred dollars (\$4,932,300). Using twelve per cent (12%) and eighty-eight per cent (88%) as the basis of proration Mexico's share of the cost of the project would be five hundred ninety-one thousand eight hundred

<sup>7</sup> Exhibits not printed here.



seventy-six dollars (\$591,876) and that of the United States four million three hundred forty thousand four hundred twenty-four dollars (\$4,340,424).

(13) On the basis that this report and the engineers' statement have been prepared and submitted with the view of generally straightening the present river location between the International Dam above El Paso-Juarez and the Box Canyon below Fort Quitman, the question of using the present river at Fabens or following the boundary route on the south of the San Elizario area is left for later determination. From the data at hand, apparently there is argument in favor of both routes. Following either the present river or the boundary line route requires adjustment of detached areas, and the proposed channel below this section can be so located as to compensate for any inequalities of such areas.

(14) The following are the recommendations of the Commission:

(a) The Commissioners recommend that the two Governments approve the plan for river rectification as outlined in the attached engineering report, including the feature of the flood retention dam, the general straightening of the present river location and the establishment of a flood channel which generally will follow and straighten the present river from International Dam to the Box Canyon below Fort Quitman.

(b) That both countries in view of the serious situation proceed to an agreement, without delay, which will carry into effect the engineering and construction features as outlined in the attached report.

(c) That the International Boundary Commission be authorized to prepare detail plans, and to direct and supervise the construction and all other engineering operations, utilizing such established governmental agencies as each government may deem proper.

(d) That each section of the International Boundary Commission be authorized to acquire for its country the necessary rights-of-way and detached areas located within its territorial limits, thru the proper governmental agencies.

(e) That agreement between the two Governments provide for the exchange of one-half of the area required for right-of-way and the total area of detached tracts of each country.

(f) That the total proratable cost of four million nine hundred thirty two thousand three hundred dollars (\$4,932,300) be divided between Mexico and the United States on the basis of twelve per cent (12%) and eighty-eight per cent (88%) respectively, and that each Government provide annually such required appropriations as will complete the work in four or five years.

(g) That the agreement between the two countries provide for the jurisdiction of the International Boundary Commission over all matters concerning the rectified channel.

(h) That this Commission be authorized to adopt such rules and regulations as it may deem necessary to the end that the preservation of the rectified channel may be perpetuated.

(i) That each country hold the other immune from all private or national claims arising from the construction and maintenance of the rectified channel or any other cause whatsoever in connection with this project.

Respectfully submitted.

The Commission adjourned to meet again at the call of either of the Commissioners.

L. M. LAWSON

*Commissioner for the United States*

GUSTAVO P. SERRANO

*Commissioner for Mexico*

MERVIN B. MOORE

*Acting Secretary of the United States Section*

JOSÉ HERNÁNDEZ OJEDA

*Secretary of the Mexican Section*

JOINT REPORT OF CONSULTING ENGINEERS RIO GRANDE RECTIFICATION EL PASO-JUAREZ VALLEY

MEXICO, D.F.

*July 16, 1930*

I. INTRODUCTION

1. *Outline of Proposed Plan*

(a) It is proposed to reduce materially the flood flow at El Paso-Juarez by the construction of a detention dam with a one hundred thousand (100,000) acre foot (123,350,000 cubic meter) reservoir at Caballo, and to control this flood flow thru the El Paso-Juarez Valley in a shortened channel by the construction of parallel levees. The proposed artificial channel will follow and rectify, in a general way, the present river from Land Monument Number One to the Box Canyon below Fort Quitman, and is so located as to segregate the same area from each country.

(b) The general engineering features of the project involve: the reduction of river length from one hundred fifty-five (155) miles (247 kilometers) to eighty-eight (88) miles (141 kilometers); the establishment between levees of a floodway five hundred ninety (590) feet (180 meters) wide with a capacity of eleven thousand (11,000) second feet (314 cubic meters per second); and the increasing of the gradient from a slope of .00035 (1.82 feet per mile) to a slope of .00061 (3.20 feet per mile). The levees require

the placement of eight million nine hundred eighty-five thousand (8,985,000) cubic yards (6,870,000 cubic meters) of earth, their average height being 7.5 feet (2.25 meters). Four million seven hundred seventy-five thousand (4,775,000) cubic yards (3,650,000 cubic meters) of earth are required to be excavated to provide artificial channel. The areas required for right-of-way for this channel are four thousand seventy-five (4,075) acres (1650 hectares) from the United States and also four thousand seventy-five (4,075) acres (1650 hectares) from Mexico.

(c) The tentative proposed location of the rectified channel segregates three thousand four hundred sixty (3460) acres (1400 hectares) from the United States and also three thousand four hundred sixty (3460) acres (1400 hectares) from Mexico.

(d) The estimated cost of the project, including Caballo Dam, is about six million (6,000,000) dollars.

(e) This project will eliminate the flood menace throughout the El Paso-Juarez Valley in both the United States and Mexico, will prevent channel changes and detachment of areas from one country to the other, and will permit the reclaiming of low-lying areas.

## 2. *Present Conditions*

(a) The Rio Grande forms generally the International Boundary between the United States and Mexico from Land Monument Number One to the Box Canyon below Fort Quitman in the El Paso-Juarez Valley, and is a meandering stream subject to changes, creating detached areas from one country to the other.

(b) The gross area of valley land in both the United States and Mexico, between El Paso-Juarez and the Box Canyon, is one hundred sixty-five thousand (165,000) acres (66,000 hectares) of which ninety six thousand (96,000) acres (38,400 hectares) are in the United States and sixty-nine thousand (69,000) acres (27,600 hectares) are in Mexico. Estimated values existing in the cities of El Paso and Juarez and their valleys, including irrigation and drainage works and improved roads, are in excess of one hundred million dollars (\$100,000,000).

(c) Notwithstanding the fact that the present total amount of sediment annually carried thru this valley by the Rio Grande is only a very small percentage of that carried previous to the construction of the Elephant Butte Dam, the absence of the former large scouring floods has resulted in the silting up of the river channel to a point where rainfall discharges from arroyos entering the river between Elephant Butte and El Paso-Juarez menace the improved and developed properties of both cities and valley lands. Only large floods of destructive proportions are capable of eroding accumulations of sediment as they now occur in the meandering channel.

(d) The Mexican Department of Communications and Public Works and the city and county of El Paso have expended in the last few years over

seven hundred fifty thousand dollars (\$750,000) to protect the cities of El Paso-Juarez and the Valley lands from floods. These works consist largely of levees built along the banks of the meandering channel, and require constant strengthening and repair on account of the raising of the river bed. A more substantial and effective plan must be adopted to secure permanent and efficient protection.

## II. DETAIL REPORT

Since the joint preliminary report, dated December 1928, was submitted to the Commission, location surveys covering the entire length of river from the cities of El Paso and Juarez to Quitman Canyon have been completed. These surveys have furnished additional data, and form in a large measure the basis for the report which follows.

### 1. *Description*

(a) The Rio Grande is a sediment bearing stream and as such is constantly building up its bed, and would from this cause, in time of flood, change its channel to a lower location where it would again start building up its bed and repeat the cycle at some future flood stage. This phase of changing channel has been largely prevented thru El Paso-Juarez Valley by the construction of artificial works, such as railroad and road grades, canal and drain banks, and in late years, levees. Under these conditions the river bed has been continuously elevated. The Elephant Butte Dam was completed in the year 1916, and as a result of its function of providing an irrigation supply during years of low run-off, it stores the floods, which previous to its construction had passed on down the river. The action of these floods was to scour out the river channel, partly by carrying deposits on thru the valleys and partly by making deposits upon the valley floor whenever bank overflow stage was reached. The absence, since the completion of Elephant Butte Dam, of large scouring floods has changed the characteristics of the river channel thru the El Paso-Juarez Valley. Although large floods have been controlled behind the Elephant Butte Dam, smaller floods from the run-off area lying between Elephant Butte and El Paso-Juarez are of annual occurrence. These usually occur during the rainy season, that is, in August and September, and are generally flashy in character, the peak lasting only a few hours, and would pass harmlessly thru the valley were it not for the elevated bed.

(b) With the first release of clear water from Elephant Butte, a limited scouring of the river channel began immediately below the dam. The clear water picked up the finer particles of silt and sand and carried them downstream. This effect has reached some forty miles (64 kilometers) below Elephant Butte, and might eventually reach El Paso-Juarez and degrade the river thru the El Paso-Juarez Valley, were it not for the annual increment of sand, gravel and silt brought into the river channel from the many side

arroyos which debouch into the stream along its course between the dam and El Paso-Juarez. Even this annual increment of sand might be carried on were it not for the need of diverting the flow onto lands for irrigation. Three diversions are made above El Paso, one each at Percha, the Leasburg, and the Mesilla Dams. The main diversions in the El Paso Valley are at the International Dam, where lands of both countries are served, and at the Riverside and Tornillo headings, where supplementary diversions to American lands are made. At each of these diversions sand skimming and canal sluicing devices are used so that a great percentage of the sand and silt is returned to the river bed, while a great percentage of the water is diverted for the irrigation of the lands. This process continuously returns the sand to the river bed while also continuously depleting the volume, and hence the carrying capacity.

## 2. *Caballo Dam and Reservoir*

(a) The uncontrolled drainage areas which lie between Elephant Butte and El Paso-Juarez total about eight thousand (8,000) square miles (20,700 square kilometers). Large parts of this area have dead drainage with no direct outlet into the Rio Grande. About two thousand three hundred (2300) square miles (6,000 square kilometers) drain directly into the river, of which some one thousand two hundred (1200) square miles (3100 square kilometers) are above and would be controlled by a dam constructed at the Caballo site.

(b) This damsite is located in Sierra County, New Mexico on the Rio Grande about twenty-two (22) miles (35 kilometers) below Elephant Butte Dam. Studies of the Caballo Dam and the resulting reservoir have been made by the Bureau of Reclamation, Department of the Interior, United States Government, in conjunction with the proposed water power development at Elephant Butte. These studies were begun in the year 1924 and included the surveying of the site, the testing of the foundation, the design and cost estimates of structures of various heights, and the effect on water supply and flood control. Two reports were written by the United States Bureau of Reclamation engineers, covering this dam and related features, one dated December 15, 1924, and the other April 1925.

## 3. *River Discharge at El Paso-Juarez*

(a) Floods at El Paso-Juarez occurring since the completion of Elephant Butte Dam have been built up from the run-off of the area between Elephant Butte and El Paso-Juarez, supplemented by the concurrent irrigation discharge from the reservoir. There is a possibility that such floods would be increased at such times when the reservoir was full and water passing over the spillway.

#### 4. *Probable Spill at Elephant Butte Dam*

(a) An estimate of the probable spill at Elephant Butte Dam has been made from a study of the spills as shown in the report of the Denver office of the Bureau of Reclamation, dated March 10, 1928 and entitled "Review of Quinton, Code and Hill Reports on Elephant Butte Power Development of July 2, 1927 and September 30, 1927". This review sets up the following assumptions:

1. Irrigation storage is to be carried to elevation 4401, leaving six feet (1.83 meters), or the elevation 4407, for flood control storage. This six feet (1.83 meters) will store two hundred thirty-nine thousand (239,000) acre feet (294,806,000 cubic meters). Additional flood control storage of about one hundred thousand (100,000) acre feet (123,350,000 cubic meters) is available to elevation 4410, at which height a discharge of about four thousand five hundred (4,500) second feet (128 cubic meters per second) will be passing over the spillway crest.

2. Irrigation demand is to be limited to seven hundred thousand (700,000) acre feet (863,450,000 cubic meters) annually when on June 30th of any year the reservoir content is less than one million five hundred thousand (1,500,000) acre feet (1,850,250,000 cubic meters). Irrigation demand is to be limited to seven hundred eighty-seven thousand (787,000) acre feet (970,764,000 cubic meters) annually when on June 30th of any year the reservoir content is more than one million five hundred thousand (1,500,000) acre feet (1,850,250,000 cubic meters).

3. Reservoir capacity depletion thru silt deposit is at the average rate of twenty thousand (20,000) acre feet (26,670,000 cubic meters) per year.

4. San Marcial, New Mexico inflow records are corrected for changed conditions above.

5. The cycle of inflow, with the corrections, will repeat using the year 1898 as equal to 1930; the reservoir was full on January 1, 1898, and the irrigation storage capacity had been depleted by silt inflow to two million one hundred thousand (2,100,000) acre feet, (2,580,350,000 cubic meters) on that date.

(b) These assumed conditions required the theoretical use of flood storage in the years 1930, 1937, 1944, 1948, 1953, 1954, and 1956, with the maximum requirements coming in 1956. If a flow of four thousand five hundred (4500) second feet (128 cubic meters per second) was started in 1956 at the time the water reached elevation 4401 or the limit of irrigation storage a flow over the spillway of 4500 second feet (128 cubic meters) would have been just reached at the end of the flood. This condition occurs but once in the assumed cycle of thirty years and spill has not been necessary during the fifteen years of actual reservoir operation 1915-1930. Therefore, it seems safe to assume that the probable spill from Elephant Butte Dam will

not at any time be more than six thousand (6,000) second feet (171 cubic meters per second).

#### 5. *Probable Floods at El Paso-Juarez*

(a) The largest flood at El Paso-Juarez since the building of Elephant Butte Dam occurred on September 1, 1925 when a peak of thirteen thousand five hundred (13,500) second feet (382 cubic meters per second) passed the gaging station at Courchesne. This flood resulted from heavy rainfall in the Black Range between Elephant Butte and Leasburg, on top of a flow of two thousand (2000) second feet (57 cubic meters per second) already released from the reservoir. If a spill of six thousand (6000) second feet (170 cubic meters per second) was occurring at the time of this flood, a peak of about eighteen thousand (18,000) second feet (510 cubic meters per second) would have occurred at El Paso-Juarez. If the Caballo Dam and reservoir had been available at the time of this flood, and if the six thousand (6000) second feet (170 cubic meters per second) of spill was occurring at Elephant Butte, prior information of rain on the tributaries would have permitted the closing of the Caballo gates before the flow of the tributaries could have reached the Rio Grande, and the resulting peak at El Paso-Juarez could have been reduced to between ten thousand (10,000) and eleven thousand (11,000) second feet (283 and 314 cubic meters per second). The Caballo reservoir, by controlling one-half of the direct drainage area, and by acting as a temporary check on the spills from Elephant Butte Dam will reduce by almost one-half the probable peak at El Paso-Juarez.

#### 6. *Drainage Area in El Paso-Juarez Valley*

##### *At El Paso-Juarez*

(a) The Arroyo Colorado empties into the river immediately above the city of Juarez, Chihuahua, Mexico. This arroyo has been estimated to have had a peak flood of some three thousand (3,000) second feet (85 cubic meters per second). Other smaller arroyos empty into the river directly above the International Dam. Their drainage areas are small, and their discharge, together with that of the Arroyo Colorado, cannot increase the peak floods in the Rio Grande except in the improbable event of their occurrence simultaneously with the peak flow past El Paso-Juarez. Additional freeboard has been allowed in the design to take care of this improbable occurrence.

##### *Below El Paso-Juarez*

(b) Practically no direct discharge of side drainage occurs below El Paso-Juarez until the Arroyo Alamo in Hudspeth County is reached. Below this point three large arroyos and many small ones empty directly into the river. The total drainage area on the American side between the Arroyo Alamo and Quitman Canyon is six hundred eighty (680) square miles (1760

square kilometers), of which four hundred ninety (490) square miles (1270 square kilometers) have direct discharge into the river and one hundred ninety (190) square miles (490 square kilometers) are indirectly discharged into the river. The drainage area on the Mexican side is considerably less, although, due to the absence of maps, little detail knowledge is available. However, no arroyos empty directly into the river from the south until considerably below the town of McNary, Texas, and observations of the arroyo channels below this point show that their drainage areas are probably limited and their discharges small.

(c) The three largest arroyos on the American side are: the Alamo, with a drainage area of one hundred forty-five (145) square miles (375 square kilometers); the Diablo, with a drainage area of sixty-two (62) square miles (160 square kilometers); and the Guayuco, with a drainage area of one hundred sixty-five (165) square miles (427 square kilometers). The Alamo and the Guayuco have been known to discharge in excess of five thousand (5,000) second feet (142 cubic meters per second), and hearsay information gives probable peaks of twice that amount. If such flows should occur at the time the peak of a flood from upper river sources was passing, doubtless the designed channel would be overtaxed. Some additional safety has been provided by increasing the freeboard a short distance above and below these arroyos. However, as these arroyos empty into the river channel well below most of the area to be protected, it will be uneconomical to make any large expenditures against unlikely possibilities.

(d) The discharge from these arroyos must be taken into the channel and the location has been made at some distance from the present arroyo mouths to permit, in a measure, the deposit of detritus before the flows reach the channel.

#### 7. *The River Above El Paso-Juarez*

(a) The distance by the river between Elephant Butte and El Paso-Juarez is about one hundred fifty (150) miles (241 kilometers), and the valley axial distance is about one hundred twenty (120) miles (193 kilometers). Immediately below the dam the river passes thru fifteen miles (24 kilometers) of canyon where the fall varies from .00037 (1.94 feet per mile) to .00080 (4.26 feet per mile) then thru the Palomas Valley for thirteen miles (21 kilometers) with a fall of .00080 (4.26 feet per mile), then thru three miles (5 kilometers) of canyon where the Caballo damsite is located, then thru the Rincon Valley, the first seven miles (11 kilometers) of which have an average fall of .00074 (3.93 feet per mile), and the last fourteen miles (22 kilometers) a fall of .00064 (3.40 feet per mile). The river then traverses seven miles (11 kilometers) known as the Selden Canyon, where the average fall is .00064 (3.4 feet per mile), and then reaches the Leasburg Dam which is at the head of the Mesilla Valley. From Leasburg Dam to Mesilla Dam, a distance of twenty four miles (39 kilometers), the river has a fall of .00073



(3.84 feet per mile). From Mesilla Dam to Canutillo Bridge, a distance of twenty-eight miles (45 kilometers) the river has a fall of .00070 (3.67 feet per mile), and from the Canutillo Bridge to the International Dam, some nineteen miles (30 kilometers) the river has a fall of .00048 (2.53 feet per mile).

(b) As previously stated, the effect of the release of clear water from Elephant Butte Dam has been to degrade the river bed in the upper reaches immediately below the dam, and to build it up thru the El Paso-Juarez Valley. There is necessarily a stretch of river between these two actions which is quiescent, where neither degradation nor building up is going on. Studies of river sections indicate that the river bed thru the lower Mesilla Valley rests in this state.

#### 8. *The River Below El Paso-Juarez*

(a) The length of the channel of the river between El Paso-Juarez and the Quitman Canyon is about one hundred fifty-five (155) miles (250 kilometers) while the length measured along the valley axis is eighty-five (85) miles (137 kilometers). The fall of the river is about .00034 (1.82 feet per mile) while the fall of the valley is .00061 (3.20 feet per mile). It is thus seen that if the alignment of the river can be straightened a fall of approximately .00061 (3.2 feet per mile) can be obtained. It will be noted that this fall is in excess of that in the last stretch of the Mesilla Valley, or between Canutillo Bridge and the International Dam, where a fall of .00048 (2.53 feet per mile) was indicated and that this fall of .00061 (3.2 feet per mile) is somewhat under that of .00070 (3.67 feet per mile) for the upper part of the Mesilla Valley. If the lower stretch of the river in the Mesilla Valley is in equilibrium, that is, shows neither scour nor fill, with a gradient of .00048 (2.53 feet per mile) the river thru the El Paso-Juarez Valley must have a greater gradient to reach the same state of equilibrium since the quantities of water normally carried are greatly reduced at the International Dam.

### III. PROPOSED PLAN

(a) The treatment to be given the river thru the valley to increase the fall from .00034 (1.82 feet per mile) to .00061 (3.2 feet per mile), in order to accelerate the velocity and to let the current of the river carry along the burden of sand and sediment, which has caused the rapid river bottom rising, so marked since the construction of the Elephant Butte Dam, consists of a general straightening following the present channel of the river wherever possible, and cutting across the bends where necessary to decrease length. Along each side of the new channel, and also along each side of the present river where followed, levees will be built of sufficient height and far enough apart to pass the floods. The channel thus created will always be kept clear of brush and other obstructions which might retard the flow. In the align-

ment, due consideration has been given to the general principle of the compensation of the artificially segregated areas, in order to equalize the areas which will be cut from one country with those which will be cut from the other.

(b) This treatment brings about the result that the right-of-way to be acquired by each nation will balance practically in area. In general, the waterway proposed will consist of a normal channel of similar size and capacity to the present river bed, with levees set back with a total distance of about five hundred ninety (590) feet (180 meters) between them. Levees will be wide enough on top to permit travel for inspection and repair. The alignment has been so chosen as to avoid as far as possible all highly improved and cultivated areas, but at many places this was impracticable due to the meanderings of the river channel.

(c) The above plan of shortening the river by cut-offs is feasible in this case because Elephant Butte Dam, in conjunction with the proposed Caballo Dam and reservoir, will give practically complete control of the floods. Consequently the river through the El Paso-Juarez Valley will take on more the nature of a large central drain or canal than a river.

#### IV. BASIS OF ESTIMATE

##### 1. *Cost of Caballo Reservoir*

(a) The cost of the Caballo Dam, including the purchase of the lands to be submerged, has been estimated by the Bureau of Reclamation at about one million two hundred fifty thousand dollars (\$1,250,000) for the one hundred thousand (100,000) acre feet (123,350,000 cubic meters) capacity.

(b) The volume of water passing the Caballo Damsite during the flood of September 1925 was in the neighborhood of twenty-five thousand (25,000) acre feet (30,837,000 cubic meters). Storage in excess of this amount must be provided to take care of possible larger floods and silt depletion. Provision must also be made to store the probable spill from Elephant Butte during times of flood run-off below the dam. Fifty thousand (50,000) acre feet (61,675,000 cubic meters) are allowed for this item and would probably store three or four days' spill. This would permit the floods entering below Caballo to have receded.

(c) Of the total proposed storage of one hundred thousand (100,000) acre feet (123,350,000 cubic meters) approximately fifty thousand (50,000) acre feet (61,675,000 cubic meters) are allowed for flood storage and silt depletion, and fifty thousand (50,000) acre feet (61,675,000 cubic meters) for the control of spill from Elephant Butte.

##### 2. *Segregated Tracts*

(a) In order that neither nation shall sacrifice national area, it is required that the total land to be segregated or cut off from one country shall

equal that to be segregated or cut off from the other. On the attached maps these tracts and their total areas have been shown. Fifty-nine (59) separate tracts will be cut from Mexico and sixty-five (65) separate tracts will be cut from the United States. Their areas vary from 0.10 hectares (.25 acre) to 151 hectares (377 acres). The approximate total area to be cut from Mexico is one thousand four hundred (1400) hectares (3460 acres) and the approximate total area to be cut from the United States is one thousand four hundred (1400) hectares (3460 acres).

### 3. *San Elizario Island*

(a) Two alternate routes for the location of the rectified channel along the San Elizario Island are shown on Exhibit No. 2. One route follows in a general way the present river while the other follows in a general way the present boundary. The two routes are almost identical in length, and have practically the same gradient and grade elevation.

(b) The river route, by following the present river, is located entirely in the United States and passes thru areas largely undrained and uncultivated, while the boundary route passes largely thru highly cultivated and valuable areas. Therefore the costs of rights-of-way will be less with the river route and no areas will be segregated in the sense of changed national jurisdiction. The alignment possible with the boundary route is considerably better than that of the river route, especially at the lower end of the Island, where a sharp curve is necessary if the river route is used.

(c) The boundary route makes more feasible the carrying thru of irrigation and drainage works needed by Mexico, as the present boundary in places is located practically against the toe of the mesa. On the other hand, the abandonment of the river requires the building in the United States of a feeder canal to reestablish water deliveries to the Tornillo Canal system.

(d) The boundary route is estimated to cost about seventy-five thousand dollars (\$75,000) more than the river route, due largely to the higher value of the lands required for the right-of-way and the segregated areas, and to the disestablishment of some of the irrigation and drainage works now constructed in the United States of America with the river in its present location. The equalizing of all the segregated tracts and the estimate submitted herewith both are based on following the boundary route along the San Elizario Island.

## V. GENERAL

### 1. *Velocities*

(a) The requirements of the project indicate two important limiting velocities; namely, that the maximum velocity in the flood channel at full flow must not entail expensive bank protection, and that the minimum velocity in the normal flow channel must be high enough to carry the annual increment of sand and silt to prevent channel upbuilding.

(b) The increase in average gradient, which is from .00035 to .00061, or from 1.82 feet per mile to 3.2 feet per mile, and which is brought about by the shortening in the river length, will produce velocities of from five to six feet (1.52 to 1.83 meters) per second at full flow, depending on the cross section and the gradient of the particular section considered.

(c) These velocities can be safely carried in the channel designed for this project where the alignment is reasonably straight and the cross section relatively wide.

(d) The data on normal flow indicates that the low water channel will have a velocity of around three feet (0.91 meters) per second. Experience on the Rio Grande Irrigation Project, in the sluicing of canals in the design of sand skimming devices, has shown that such velocities are capable of carrying the usual sand and silt borne by the Rio Grande.

## 2. *Coefficient of Roughness*

(a) The value of "n" in Kutter's Formula adopted for use on this project is  $n=.025$  for the normal flow channel and  $n=.030$  for the flood channel. These values follow closely those determined on the Miami Conservancy District at Dayton, Ohio, taking such tests as are believed to nearly duplicate the conditions to be encountered on this project. On one particular determination where the channel was covered with weeds, and the flow was around twenty-three thousand (23,000) second feet (6520 cubic meters per second) the value of "n" was determined to be .0298, whereas the values for the same channel when free from weeds varied from .023 to .0255.

## 3. *Cross-sections*

(a) The cross-sections adopted as best suited to the requirements of the project are shown on the attached Exhibit No. 3. It will be noted that two cross-sections are shown. These are identical except in the placement of the normal flow channel. The one to be used from El Paso-Juarez to the lower end of the San Elizario Island places the normal flow channel in the center while the one to be used from the lower end of the San Elizario Island to the mouth of Quitman Canyon places the normal flow channel adjacent to the left levee. This different treatment of the two sections of the river is required because, in the upper part, the land passed thru in the making of cut-offs is generally low ground lying from only slightly above the proposed river grade to, in some cases, slightly below the proposed grade. Thru this section the amount of material to be excavated from the proposed new channel is small and can be wasted adjacent to the normal flow channel without seriously decreasing flood channel capacities. Throughout the lower section deeper cuts are encountered and spoiling into the flood channel is impracticable. This changed condition is met by placing the normal channel adjacent to the left levee where the material excavated can be placed to form the left levee or can be wasted beyond the flood channel.

(b) The proposed cross-section has levees spaced 180 meters (590 feet) apart with levee heights of about 2.2 meters (7.2 feet). In actual construction levee heights will vary from nothing, where bench lands are encountered, to four and a half meters (15 feet) where the old river channel is crossed. The levee section proposed has a five meter (16.4 feet) crown with side slopes of two to one. This will permit the use of the top as a road for inspection and repair.

(c) The normal flow channel is designed with a bottom width of twenty meters (66 feet) as this channel width seems to best fit the present channel width of the river. Side slopes are 1:1 except throughout the lower section where 2:1 slope is proposed on the side adjacent to the left levee.

(d) Gradients vary from .00045 (2.38 feet per mile) to .0008 (4.26 feet per mile) and the levee heights have been changed to conform, always adding 0.6 meters (2 feet) as freeboard.

(e) The estimated capacity below the 0.6 meters (2 feet) freeboard varies from ten thousand seven hundred (10,700) second feet (3,030 cubic meters per second) to eleven thousand five hundred (11,500) second feet (3,260 cubic meters per second).

#### 4. *Right-of-way*

(a) The total right-of-way required is eight thousand one hundred sixty (8,160) acres (3,300 hectares). This is equally divided between the two countries to Mexico four thousand eighty (4,080) acres (1650 hectares) and to the United States four thousand eighty (4,080) acres (1650 hectares). In addition to the land actually occupied by the works, a strip fifteen meters (49 feet) wide outside the land tow of each levee has been included for use in levee maintenance or possible future levee widening.

#### 5. *Clearing*

(a) The area to be cleared is estimated as seventy per cent of the total area required for the right-of-way. A part of the right-of-way is now cleared and in cultivation, and in addition a considerable part is now occupied by the present river. Unit cost is sixty-two dollars fifty cents per hectare, or about twenty-five dollars per acre. The work to be done consists of brush cutting, some grubbing, and the plowing of the area between the borrow pits and the normal channel.

#### 6. *Earthwork*

(a) All earthwork of both channel excavation and levee embankment is planned to be accomplished by machine methods, and the unit cost used in the estimates is eighteen cents per cubic meter which is about that developed on similar work in that locality. The machines best suited to the work are draglines equipped with one hundred foot booms, with buckets from two to three cubic yards in capacity, although on a great part of the levee work

smaller equipment can be used economically. Proper provision has been made in the unit cost for full machine upkeep and depreciation, and for the hazards of the work such as untimely high water, soft and marshy ground and unusable soft material.

(b) It is planned to secure material for the levee embankment from the channel excavation in building the left levee from the lower end of San Elizario Island to the mouth of Quitman Canyon. At practically all the other locations the material will be secured from discontinuous borrow pits located on the channel side of the levees. Practically no material will require a second handling.

#### 7. *Work near El Paso-Juarez*

(a) The item of one hundred twenty five thousand dollars (\$125,000) covers contemplated work on the section of river between International Dam and Cordova Island, and includes the extension and straightening of the present levees, the removal of existing obstructions, and purchase of title to all lands lying on the channel side of the present levees.

#### 8. *Changes in Canals and Drains*

(a) The sum of two hundred twenty five thousand dollars (\$225,000) is carried in the estimate to cover the cost of rebuilding all constructed irrigation and drainage works where they will be interfered with by the proposed river work. This work will include the rearrangement of the irrigation systems on both sides of the river, especially in the area below Monument No. 1 of San Elizario Island, and changed drain outlets on the United States side in the same area. The sum of seventy-five thousand dollars has been allocated to Mexico and one hundred fifty thousand dollars to the United States.

#### 9. *Bridges*

(a) Present bridges will either have to be lengthened or moved, depending on how they fit with the new plan and probably several more bridges will have to be built. The estimate of the amount of this item is three hundred thousand dollars (\$300,000).

#### 10. *Grade Controls*

(a) Because the effects of the introduction of steeper gradients in the river channel are problematical, and considerable scour may develop, and because the irrigation supply must be diverted at certain places, there has been set up in the estimate an amount of dollars 675,000 to meet the cost of grade control structures. This amount is deemed sufficient to build ten such structures. The immediate construction of three or four is contemplated—located at such places as the need of irrigation diversion dictates. The others will be built if their need becomes apparent.

### 11. *Engineering, Contingencies and Overhead*

(a) An allowance of twenty per cent has been added to cover the cost of the above item. A relatively low engineering cost should result, due to the magnitude of the quantities involved. Contingencies are not serious, as the flow of the river is largely controlled by Elephant Butte Dam, and no long-lasting floods are probable. Overhead should be no higher than on other similar work.

#### VI. COST WITHOUT CABALLO DAM

(a) During December 1928, a report was made on the probable floods at El Paso-Juarez, with and without, the additional flood control of a retention reservoir at Caballo. The data then available indicated a maximum flood of eight thousand (8,000) second feet (226 cubic meters per second) with the Caballo Dam, and a maximum flood of eighteen thousand second feet (510 cubic meters per second) without the Caballo Dam. Since that time additional data has been acquired, and restudies have shown that the assumed maximum flood with the Caballo Dam should be eleven thousand second feet (314 cubic meters per second), and that the assumed maximum flood without the Caballo Dam should be twenty thousand second feet (576 cubic meters per second).

(b) In adopting a design for the twenty thousand second feet (576 cubic meters per second) channel it was found necessary to increase the distance between levees from one hundred eighty meters (590 feet) to two hundred ninety meters (950 feet) for the upper part of the valley, or from El Paso-Juarez to Alamo Arroyo. For the lower part, or from Alamo Arroyo to the end it was found necessary to increase the size of the excavated channel from twenty meter (66 foot) base to a thirty meter (99 foot) base, and to raise the levees one meter (3.3 feet).

(c) Estimates show that the works required from Land Monument No. 1 to the mouth of the canyon below Fort Quitman will cost about one million five hundred thousand dollars more when designed for the twenty thousand second foot (576 cubic meters per second) channel than when designed for the eleven thousand second foot (314 cubic meters per second) channel. The principal items of difference are the increase in rights-of-way required due to the widening between levees in the upper part, or from El Paso-Juarez to the Alamo Arroyo; the increase in earthwork, due principally to the larger cross-section needed thru the deep cuts below the Alamo Arroyo, and to the lengthening of the grade control structures and the bridges. There is also an increase in the amount of clearing necessary.

(d) The additional area required for rights-of-way is about eight hundred hectares (2,000 acres) and will cost one hundred thousand dollars. The additional earthwork required is about four million one hundred fifty thousand cubic meters (5,424,000 cubic yards) which at eighteen cents per cubic meter amounts to seven hundred forty-seven thousand dollars. The length-

ening of grade control structures and bridges will cost an additional three hundred fifty thousand dollars. The additional clearing required will cost thirty-five thousand dollars. The total of the above items is one million two hundred thirty-two thousand dollars which, when increased by twenty per cent allowed for engineering, overhead and contingencies, makes a total additional cost of one million four hundred eighty thousand dollars.

(e) Therefore, the cost (\$1,250,000) of the Caballo Dam is more than offset by the economies made possible in the works from Land Monument No. 1 to the mouth of Quitman Canyon. Indeed, a saving of two hundred fifty thousand dollars is achieved. This saving is in addition to a reduction of 800 hectares (2,000 acres) in the land used for the channel which would be otherwise irredeemably lost for cultivation, and to an unknown amount annually saved in less expensive maintenance.

#### VII. RECOMMENDATIONS

The following recommendations are respectfully submitted:

(a) That the rectified channel be constructed as described and outlined in this report and the attached exhibits.

(b) That a flood detention dam, with a reservoir of not less than one hundred thousand acre feet (123.350,000 cubic meters) capacity be built at Caballo, New Mexico.

(c) That the areas to be detached from each country be brought into balance by such shifting of the river location as the Commission may decide.

(d) That the areas to be detached and those required for right-of-way be acquired by each nation so that all private rights to these lands be extinguished.

(e) That the balanced detached tracts and the acquired rights-of-way be exchanged between the two nations so that each nation will have jurisdiction to the center of the rectified channel where it forms the boundary line.

(f) That the International Boundary Commission have full control over the work during its construction, and over its maintenance when completed.

#### VIII. EXHIBITS

Five exhibits are attached, as follows:

##### EXHIBIT No. 1. River Gradients

This shows graphically the present river gradients between Elephant Butte and Quitman Canyon, and the proposed new gradient which the river shortening will bring about.

##### EXHIBIT No. 2. Location Map

This is a map of the El Paso-Juarez Valley on which is shown the located line and the segregated areas in color and in numerical table. Two routes are



shown at the San Elizario Island, one following generally the present river, and the other following generally the present boundary.

EXHIBIT No. 3. Typical Cross-Sections

This exhibit graphically illustrates the cross-sections proposed for use, and gives the theoretical hydraulic functions.

EXHIBIT No. 4. Drainage Areas

This exhibit indicates in colors and in figures the drainage area controlled by Elephant Butte Dam, and that to be controlled by the Caballo Dam.

EXHIBIT No. 5. Estimate of Cost

IX. ACKNOWLEDGMENTS

In the preparation of this report the Consulting Engineers have been assisted by the technical advisers, Messrs. W. E. Robertson, Chairman of the El Paso Chamber of Commerce River Rectification Committee, and Salvador Arroyo, Chief Engineer of the Juarez Flood Control Commission; and have made use of the wealth of data contained in previous reports on this problem. Acknowledgment is made to the various engineers and agencies who collected this data and made the following reports:

1. "Report on Rio Grande Rectification", by Special Committee of Engineers, El Paso Chapter, American Association of Engineers, June 5, 1922.
2. "Report of Conditions of the Rio Grande on the Rio Grande Project", by L. M. Lawson, Engineer, United States Department of the Interior, March 10, 1925.
3. "Channel Improvement of the Rio Grande below El Paso", by Salvador Arroyo, Mexican Federal Civil Engineer, March 1925.
4. "Statement to the United States and Mexican Governments and the International Boundary Commission on Rectification of a Portion of the Rio Grande, Juarez and El Paso Valleys", by Salvador Arroyo and L. M. Lawson, April 25, 1925.
5. "Joint Report on the Preceding Report" (No. 4), by Armando Santacruz, Jr. and Randolph E. Fishburn, Consulting Engineers of the International Boundary Commission, May 12, 1925.
6. "Effect of Rio Grande Storage on River Erosion and Deposition", by L. M. Lawson, Project Superintendent, United States Bureau of Reclamation, El Paso, Texas, May 1928.
7. "The Present Regimen of the Upper Rio Grande and the Problem the River has Created in the El Paso-Juarez Valley", by Salvador Arroyo, Chief Engineer of Juarez Flood Control Commission, May 1928.
8. "Statement Regarding Rectification of the Rio Grande", by J. L. Savage, Designing Engineer, United States Bureau of Reclamation, November 28, 1928.

9. "Report on Preliminary Estimates, Rectification of the Rio Grande El Paso-Juarez to Quitman Canyon", by Salvador Arroyo and C. M. Ainsworth, December 1928.

10. "Proposed Rectification of the Rio Grande from El Paso-Juarez to Quitman Canyon", by R. M. Priest, Superintendent of the Yuma Project, United States Bureau of Reclamation, May 2, 1929.

Respectfully submitted, July 16, 1930.

C. M. AINSWORTH  
*Consulting Engineer*  
*United States Section*

ARMANDO SANTACRUZ  
*Consulting Engineer*  
*Mexican Section*

To the Honorable Commissioners, International Boundary Commission,  
United States and Mexico.

#### EXCHANGES OF NOTES

*The Minister of Foreign Affairs to the American Ambassador*

[TRANSLATION]

MINISTER FOR FOREIGN AFFAIRS  
MEXICO

FEBRUARY 1, 1933

DEAR MR. AMBASSADOR:

In proceeding to the signature of the Convention relative to the rectification of the river channel of the Rio Grande in the El Paso-Juárez valley, it is understood by both Governments that the documents annexed to the Convention, as provided in Article VIII thereof, are copies of Minute 129 of July 31, 1930 of the International Boundary Commission, and of the report, maps, plans, and specifications annexed to said Minute, and that in case any difference exists between such copies so annexed to the Convention and their originals, the originals shall control.

There being nothing further to discuss, I again subscribe myself, as always, your affectionate, devoted, and faithful servant.

PUIG

MR. J. REUBEN CLARK, Jr.,  
*Ambassador Extraordinary and Plenipotentiary*  
*of the United States of America,*  
*Mexico.*

*The American Ambassador to the Minister of Foreign Affairs*

EMBASSY OF THE  
UNITED STATES OF AMERICA  
MÉXICO, February 1, 1933

MY DEAR MR. MINISTER:

Referring to your note of even date, in which you set out that in proceeding to the signature of the Convention providing for the rectification of the river channel of the Rio Grande in the El Paso-Juárez valley, it is understood that the documents attached to the Convention, as provided in Article VIII thereof, are copies of Minute 129 (July 31, 1930) of the International Boundary Commission, and of the report, maps, plans, and specifications attached to that Minute, and that in case any difference exists between such copies so attached to the Convention and their originals, the originals shall control, I beg hereby to confirm such understanding.

Please accept, Mr. Minister, the renewed assurances of my highest consideration.

J. REUBEN CLARK, Jr.

His Excellency

Señor Doctor Don JOSÉ M. PUIG CASAURANG,  
*Minister for Foreign Affairs,*  
*Mexico.*

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*The Minister of Foreign Affairs to the American Ambassador*

[TRANSLATION]

MINISTRY FOR FOREIGN AFFAIRS  
UNITED MEXICAN STATES  
MEXICO

MEXICO, September 8, 1933

MR. AMBASSADOR:

In order to facilitate the early exchange of ratifications of the Convention signed between Mexico and the United States for the rectification of the Rio Bravo (Rio Grande) in the Juarez Valley, dated February 1, 1933, and in order to establish clearly the understanding of both Governments with respect to the question of rights and use of waters of the Rio Bravo (Rio Grande) along the stretch covered by said Convention, the two Governments declare through this exchange of notes that the spirit and terms of the Convention of February 1, 1933, do not alter the provisions of Conventions now in force as regards the utilization of water from the Rio Bravo (Rio Grande) and that, consequently, these matters remain entirely unaffected and in exactly the same status as existed before the Convention of February 1, 1933, was concluded.

I avail myself of this opportunity to renew to Your Excellency the assurances of my high consideration.

PUIG

His Excellency

MR. JOSEPHUS DANIELS,  
*Ambassador Extraordinary and Plenipotentiary  
of the United States of America,  
Mexico.*

---

*The American Ambassador to the Minister of Foreign Affairs*

EMBASSY OF THE  
UNITED STATES OF AMERICA  
MEXICO, September 8, 1933

No. 187

EXCELLENCY:

In order to facilitate the early exchange of ratifications of the Convention signed between Mexico and the United States for the rectification of the Rio Grande (Rio Bravo) in the Juárez Valley, dated February 1, 1933, and in order to establish clearly the understanding of both Governments with respect to the question of rights and use of waters of the Rio Grande (Rio Bravo) along the stretch covered by said Convention, the two Governments declare through this exchange of notes that the spirit and terms of the Convention of February 1, 1933, do not alter the provisions of Conventions now in force as regards the utilization of water from the Rio Grande (Rio Bravo) and that, consequently, these matters remain entirely unaffected and in exactly the same status as existed before the Convention of February 1, 1933, was concluded.

Accept, Excellency, the renewed assurances of my highest and most distinguished consideration.

JOSEPHUS DANIELS

His Excellency

Señor Doctor Don JOSÉ MANUEL PUIG CASAURANG,  
*Minister for Foreign Affairs,  
Mexico.*